Claims

[c1] 1.An alloy comprising rhodium, platinum, and palladium, wherein said alloy comprises a microstructure that is essentially free of $L1_2$ - structured phase at a temperature greater than about 1000 ° C.

[c2] 2.The alloy of claim 1, wherein said alloy has an oxidation resistance of at least about 16 hour-cm2/mg at a temperature of about 1200 ° C.

[c3] 3.The alloy of claim 1, wherein said alloy has an E-alpha factor less than about 3.6 MPa/ ° C at a temperature of about 1000 ° C.

[c4] 4.The alloy of claim 1, wherein said alloy has an ultimate tensile strength greater than about 100 MPa at a temperature of about 1200 ° C.

[c5] 5.The alloy of claim 1, wherein said alloy further comprises a metal selected from the group consisting of zirconium, hafnium, titanium, and mixtures thereof.

[c6] 6.The alloy of claim 1, wherein said alloy comprises from about 0 atomic percent to about 5 atomic percent of a metal selected from the group consisting of zirconium, hafnium, titanium, and mixtures thereof.

[c7] 7.The alloy of claim 6, wherein said metal comprises zirconium.

[c8] 8.The alloy of claim 6, further comprising from about 0 atomic percent to about 5 atomic percent ruthenium.

[c9] 9.The alloy of claim 8, wherein said alloy is disposed in a gas turbine engine.

[c10] 10.The alloy of claim 8, wherein:

said palladium is present in an amount ranging from about 1 atomic percent to about 41 atomic percent;

said platinum is present in an amount that is dependent upon said amount of palladium, such that

a. for said amount of palladium ranging from about 1 atomic percent to about 14 atomic percent, said platinum is present up to about an amount

defined by the formula (40 + X) atomic percent, wherein X is the amount in atomic percent of said palladium, and

b. for said amount of palladium ranging from about 15 atomic percent up to about 41 atomic percent, said platinum is present in an amount up to about 54 atomic percent; and

the balance comprising rhodium, wherein said rhodium is present in an amount of at least 24 atomic percent.

[c11] 11.The alloy of claim 10, wherein:

said platinum is present up to the lesser of about 52 atomic percent and an amount defined by the formula (30+X) atomic percent, wherein X is the amount of said palladium;

said palladium is present in an amount that is dependent on the amount of said platinum, such that

a. for said amount of platinum ranging from about 0 to about 21 atomic percent, said palladium is present in an amount ranging from about 1 atomic percent to about an amount defined by the formula (15+Y) atomic percent, wherein Y is the amount in atomic percent of said platinum, and

b. for said amount of platinum ranging from about 22 atomic percent to about 52 atomic percent, said palladium is present in an amount ranging from about 1 atomic percent to about 36 atomic percent; and

the balance comprising rhodium, wherein said rhodium is present in an amount ranging from about 26 atomic percent to the lesser of about 95 atomic percent and about an amount defined by the formula (85+2Y) atomic percent, wherein Y is the amount in atomic percent of said platinum.

[c12] 12.The alloy of claim 11, said alloy comprising:

from about 21 atomic percent platinum to about 52 atomic percent platinum;

from about 22 atomic percent palladium to about 36 atomic percent palladium; and

the balance comprising rhodium, wherein said rhodium is present in an amount ranging from about 26 atomic percent rhodium to about 43 percent

rhodium.

[c13] 13.The alloy of claim 11, said alloy comprising:

from about 3 atomic percent platinum to about 29 atomic percent platinum;

from about 1 atomic percent palladium to about 6 atomic percent palladium; and

the balance comprising rhodium, wherein said rhodium is present in an amount ranging from about 70 atomic percent to the lesser of about 94 atomic percent and about an amount defined by the formula (85+2Y) atomic percent, wherein Y is the amount in atomic percent of the platinum.

[c14] 14.An alloy consisting essentially of:

palladium, in an amount ranging from about 1 atomic percent to about 41 atomic percent;

platinum, in an amount that is dependent upon said amount of palladium, such that

a. for said amount of palladium ranging from about 1 atomic percent to about 14 atomic percent, said platinum is present up to about an amount defined by the formula (40 + X) atomic percent, wherein X is the amount in atomic percent of said palladium, and

b. for said amount of palladium ranging from about 15 atomic percent up to about 41 atomic percent, said platinum is present in an amount up to about 54 atomic percent;

from about 0 atomic percent to about 5 atomic percent of a metal selected from the group consisting of zirconium, hafnium, titanium, and mixtures thereof;

from about 0 atomic percent to about 5 atomic percent ruthenium; and

the balance rhodium, wherein said rhodium is present in an amount of at least 24 atomic percent;

wherein said alloy further comprises a microstructure that is essentially free of $L1_2$ - structured phase at a temperature greater than about 1000 ° C.

[c15] 15.An alloy comprising:

from about 5 atomic percent to about 40 atomic percent platinum; and the balance comprising rhodium;

wherein said alloy further comprises a microstructure that is essentially free of $L1_2$- structured phase at a temperature greater than about 1000 ° C.

[c16] 16. The alloy of claim 15, wherein said alloy further comprises a metal selected from the group consisting of zirconium, hafnium, titanium, and mixtures thereof.

[c17] 17.The alloy of claim 15, wherein said alloy comprises from about 0 atomic percent to about 5 atomic percent of a metal selected from the group consisting of zirconium, hafnium, titanium, and mixtures thereof.

[c18] 18.The alloy of claim 17, wherein said metal comprises zirconium.

[c19] 19.The alloy of claim 18, further comprising from about 0 atomic percent to about 5 atomic percent ruthenium.

[c20] 20.The alloy of claim 19, comprising:

from about 5 atomic percent to about 30 atomic percent platinum; and the balance comprising rhodium.

[c21] 21.The alloy of claim 20, comprising:

from about 5 atomic percent to about 10 atomic percent platinum; and the balance comprising rhodium.

[c22] 22.The alloy of claim 15, wherein said alloy has an oxidation resistance of at least about 16 hour-cm2/mg at a temperature of about 1200 ° C.

[c23] 23.The alloy of claim 15, wherein said alloy has a strain to failure of at least about 2% at a temperature of about 1200 ° C.

[c24] 24.The alloy of claim 15, wherein said alloy has an E-alpha factor less than about 3.6 MPa/ ° C at a temperature of about 1000 ° C.

[c25] 25.The alloy of claim 15, wherein said alloy has an ultimate tensile strength greater than about 100 MPa at a temperature of about 1200 ° C.

[c26] 26.An alloy consisting essentially of:

from about 5 atomic percent to about 40 atomic percent platinum;

from about 0 atomic percent to about 5 atomic percent of a metal selected from the group consisting of zirconium, hafnium, titanium, and mixtures thereof;

from about 0 atomic percent to about 5 atomic percent ruthenium; and

the balance rhodium;

wherein said alloy comprises a microstructure that is essentially free of $L1_2$ - structured phase at a temperature greater than about 1000 ° C.

[c27] 27.A gas turbine engine component comprising an alloy, said alloy comprising: rhodium, platinum, and palladium;

wherein said alloy of said gas turbine engine component comprises a microstructure that is essentially free of $L1_2$ - structured phase at a temperature greater than about 1000 ° C.

[c28] 28.The gas turbine engine component of claim 27, wherein said alloy comprises:

palladium, in an amount ranging from about 1 atomic percent to about 41 atomic percent;

platinum, in an amount that is dependent upon said amount of palladium, such that

a. for said amount of palladium ranging from about 1 atomic percent to about 14 atomic percent, said platinum is present up to about an amount defined by the formula (40 + X) atomic percent, wherein X is the amount in atomic percent of said palladium, and

b. for said amount of palladium ranging from about 15 atomic percent up to about 41 atomic percent, said platinum is present in an amount up to about 54 atomic percent;

from about 0 atomic percent to about 5 atomic percent of a metal selected from the group consisting of zirconium, hafnium, titanium, and mixtures thereof;

from about 0 atomic percent to about 5 atomic percent ruthenium; and

the balance comprises rhodium, wherein said rhodium is present in an amount of at least 24 atomic percent;

wherein said alloy of said gas turbine engine component further comprises a microstructure that is essentially free of $L1_2$ - structured phase at a temperature greater than about 1000 ° C.

[c29] 29.The turbine engine component of claim 28, wherein said gas turbine engine component is a blade of an aircraft engine, a vane of an aircraft engine, a bucket of a power generation turbine engine, or a nozzle of a power generation turbine.

[c30] 30.The turbine engine component of claim 29, wherein said gas turbine engine component comprises an airfoil, and wherein said airfoil comprises said alloy.

[c31] 31.The turbine engine component of claim 30, wherein said airfoil comprises a tip section, a leading edge section, and a trailing edge section, and wherein at least one of said tip section, said leading edge section, and said trailing edge section comprises said alloy.

[c32] 32.A turbine engine airfoil comprising an alloy, said alloy comprising:

from about 21 atomic percent to about 52 atomic percent platinum;

from about 22 atomic percent to about 36 atomic percent palladium; and

the balance comprising rhodium, wherein said rhodium is present in an amount ranging from about 26 atomic percent to about 43 percent rhodium;

wherein said alloy of said turbine engine airfoil comprises a microstructure that is essentially free of $L1_2$ - structured phase at a temperature greater than about 1000 ° C.

[c33] 33.A turbine engine airfoil comprising an alloy, said alloy comprising:

from about 3 atomic percent to about 29 atomic percent platinum;

from about 1 atomic percent to about 6 atomic percent palladium; and

the balance comprising rhodium, wherein said rhodium is present in an amount ranging from about 70 atomic percent to about 94 atomic percent

and about an amount defined by the formula (85+2Y) atomic percent, wherein Y is the amount in atomic percent of the platinum;
wherein said alloy of said turbine engine airfoil comprises a microstructure that is essentially free of $L1_2$ - structured phase at a temperature greater than about 1000 ° C.

[c34] 34.A turbine engine airfoil comprising an alloy, said alloy comprising:
from about 5 atomic percent to about 40 atomic percent platinum;
from about 0 atomic percent to about 5 atomic percent of a metal selected from the group consisting of zirconium, hafnium, titanium, and mixtures thereof;
from about 0 atomic percent to about 5 atomic percent ruthenium; and the balance comprising rhodium;
wherein said alloy of said turbine engine airfoil comprises a microstructure that is essentially free of $L1_2$ - structured phase at a temperature greater than about 1000 ° C.